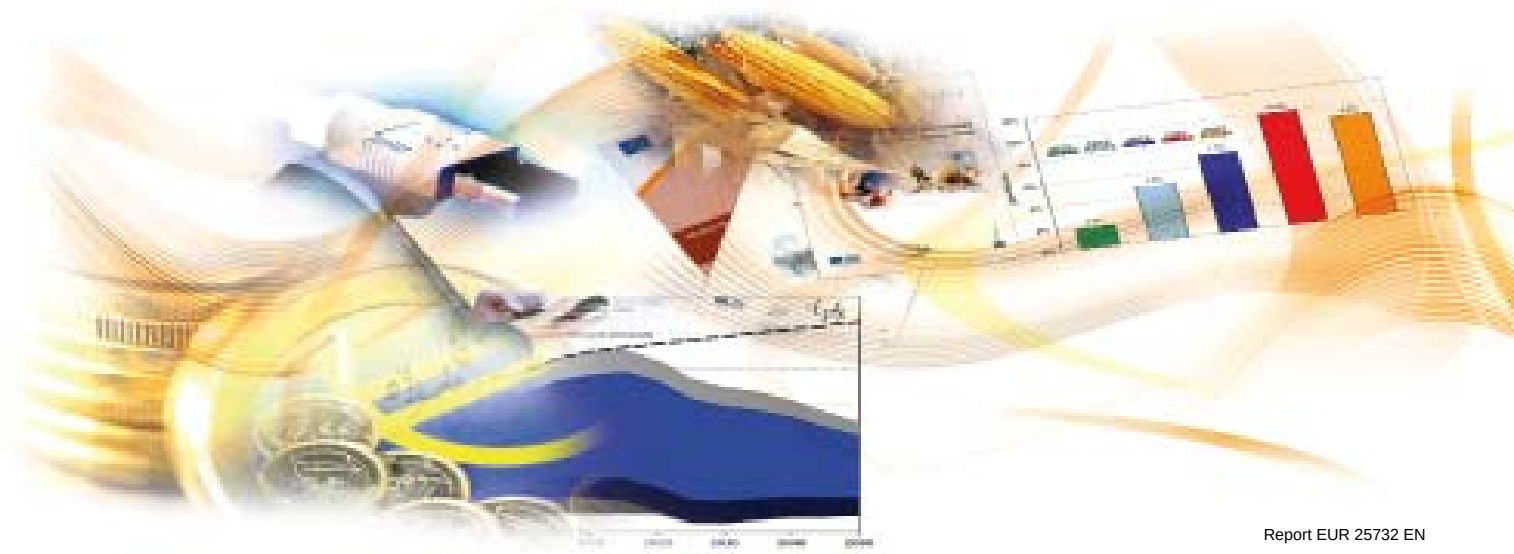
European Commission

JRC SCIENTIFIC AND POLICY REPORTS

ERAWATCH COUNTRY REPORTS 2011: United Kingdom

Paul Cunningham, Thordis Sveinsdottir & Abdullah Gok

2013



Report EUR 25732 EN

Joint Research Centre

European Commission
Joint Research Centre
Institute for Prospective Technological Studies

Contact information
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

http://ipts.jrc.ec.europa.eu
http://www.jrc.ec.europa.eu

JRC77874

EUR 25732 EN

ISBN 978-92-79-28135-8 (pdf)

ISSN 1831-9424 (online)

doi:10.2791/61743

Luxembourg: Publications Office of the European Union, 2013

Printed in Spain

Acknowledgements and further information:

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl. The report has been produced by the ERAWATCH Network under contract to JRC-IPTS. The first draft of this report was produced in November 2011 and is focused on developments taking place in the previous twelve months.

In particular, it has benefited from comments and suggestions of Tom Martin, who reviewed the draft report. The contributions and comments of yyyy from JRC-IPTS and DG-RTD are also gratefully acknowledged.

The report is currently only published in electronic format and available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

Executive Summary

The UK has the third largest population among the EU Member States, with a population of 62.4 million in 2011 (12.4% of EU). With a GDP of €1,700b in 2010, it contributes around 13.9% of the total GDP of the EU27. After two years of decline, UK GDP increased by 2.1% in 2010 and was forecast to increase by 0.7% in 2011 and 0.6% in 2012. Expenditure on GERD amounted to €30.71b in 2010, 12.2% of the aggregate EU27 R&D expenditure of €245.67b, down from 15.9% in 2006. UK R&D intensity (GERD/GDP) was 1.77% in 2010, just below the EU average of 2.0% for the same year. UK BERD for 2010 was €18.32b, up from 2009 (€17.53b) and represents 12.1% of the EU27 of €151.1b. UK GOVERD for 2010 was €2.83b, 8.7% of the EU27 GOVERD (€32.6b).

In terms of HRST as a share of the total labour force the UK ranks above the EU27 average (45.1% compared with 40.5% (Figures for 2011, Eurostat 2012)). The HE sector forms the largest performer of research and as of August 2010, there were 165 HEIs in the UK of which 115 were universities. The science base also comprises a number of Government laboratories and intramural research facilities, plus institutes and centres maintained by the Research Councils. Since 2000, the Government has allocated over €1.5b to the construction of large scientific facilities.

The UK produces 8% of the world's scientific papers and 14% of the most widely cited scientific papers are by UK authors. Of these highly cited papers the majority, 9%, are co-authored with international researchers, the highest percentage outside the US. In 2009, the UK ranked 4th amongst the G7 economies in terms of the number of patents granted by the US PTO (8,762). However, with 77.7 patents per million of population in 2006, the UK lay below the EU27 average of 106.7.

The Department for Business, Innovation and Skills (BIS) plays the lead executive role in research issues, and is the major provider of research funds for the public sector, mainly through the seven Research Councils, which in turn support R&D both in HEIs and in their own institutions. Thus, BIS forms the main author of strategic policies for R&D and innovation, while the Research Councils develop their specific R&D policies. BIS also sponsors the work of the Technology Strategy Board (TSB) which has responsibility for the formulation and delivery of the Government's technology strategy. However, the main instruments of support for private sector innovation (in financial terms) are the tax credit schemes for large companies and for SMEs.

The main recent change in the institutional set-up of the innovation governance system concerns the closure of the Regional Development Agencies, and their replacement at the local level by Local Economic Partnerships (LEPs) by April 2012. At the same time, responsibility for innovation policy at the regional level will be assumed by the TSB which will become, in effect, the innovation agency for the UK.

In 2010, the UK HE sector was responsible for €8,191m of R&D activities (26.5% of total R&D performed), slightly up on 2009. Approximately half of the funds for R&D in the UK come from the business enterprise sector (45.1% in 2010) and BERD amounted to €18,322m contributing to 62% of the UK GERD and 1.08% of

GDP (2010) – a ratio that has been in gradual decline for more than a decade, although it has levelled out and slightly increased in recent years. Government provides a third of the funds for R&D in the UK (32.1% in 2010). R&D performed by the government sector was 9.15% (€2,829m) of the total UK GERD in 2009. The intensity of the R&D performed by the government sector was 0.17% for 2010. Finally, an important characteristic of the UK research system is the relatively significant R&D investment financed from abroad (16.44% in 2010).

The gap between the UK's research intensity and those of its main European competitors is primarily due to a lower share of GDP on R&D performed by the business sector. However, this may be partially explained by the sector mix of the economy - the service sector accounts for around 75% of UK GDP and data on R&D performed is hard to capture, R&D intensive industries account for a smaller share of UK output when compared to other leading EU countries and only a small part of the innovation expenditure of UK industries is spent on R&D.

The Government's Comprehensive Spending Review (CSR) in 2010 (covering 2010/11-2014/15) announced a set of significant austerity measures. It outlined a 25% cut from the budget of BIS, plus additional annual savings to be found from the Science Budget (excluding research grants) of around €380m by 2014-15. The overall Science Budget was ring-fenced at €5.4b for the life of the Parliament, which equates to a real terms loss of 10%. BIS must find further efficiency savings of €190m per year from the Research Council institutes and universities. Capital expenditure will have to be cut by 44% by 2014-15 although certain projects have been protected. Expenditure on some areas of health research was protected, however.

While it is not possible to see any discernible shifts in the overall balance of the innovation policy mix, the recent economic crisis has precipitated some departmental cut-backs and constraints on funding. A notable casualty (although the Science Budget support was ring-fenced) has been support for HE teaching budgets. No overall shift in the share of funding borne by different sectors has been seen, although, with the removal of the Regional Development Agencies for England, the responsibility for regional support schemes has been, or is in the process of being, transferred to the Technology Strategy Board. In terms of innovation support, alterations of both the R&D Tax Credits thresholds are likely to see an increase in the amount of tax offset by the Government. In addition, there seems to have been a slight growth in the use of venture capital and other equity finance schemes which utilise third party investments, probably in an effort to shield SMEs from the effects of the credit squeeze.

The main structural challenges facing the UK tend to remain largely unchanged from previous years' analyses. These are:

- A need to address the continuing low level of private sector R&D investment, in all sectors of the economy; the principal indicators suggest that the UK performs less well in this area than its main economic comparators.
- The need to maintain a continuing policy focus on the translation of the results of publicly supported R&D into commercial products, process and services; although some indicators (e.g. industry funded R&D in universities) point to some success in this area, there is a need to improve the overall level of science-industry interaction.

- In the face of continuing economic pressures the need to maintain the present level of public funding of the science base (despite ring fencing over the next 3 years);
- Uncertainties over the future supply of human resources in S&T (in the face of university teaching cuts and the introduction of higher student fees);
- Pressure on the supply of venture capital for the growth and development of SMEs and start-ups, in the face of the decreasing availability of bank finance and other forms of equity due to the credit squeeze.

According to the latest BIS Research and Innovation Strategy (2011), there are four priorities for UK innovation policy[1]:

1. Facilitation of collaboration between organisations in the private, public and third sector, from the international to local level, to generate and apply new knowledge and to strengthen the sharing and dissemination of knowledge within the innovation system.
2. The need to maintain and develop a full scale and coherent knowledge infrastructure – the university science system, research labs and organisations, and information agencies working in design, intellectual property, quality assurance and specialist support.
3. Incentivisation of businesses across the economy to make investments into innovation. This includes attention to the innovation performance of the service sector, and of large medium and low tech industries in manufacturing, construction, energy supply, etc, all of which is crucial to the development of the UK economy.
4. Transformation of the public sector into a major driver of innovation whilst recognising that the complexity and culture of the public sector create operational barriers towards this aim.

Overall, these priorities are fully consistent with the challenges identified above.

The UK's policy mix and its guiding priorities appear to be fully consistent with the ERA pillars and objectives. The UK has a thriving and open labour market for researchers, it performs well in terms of cross border cooperation and the measures in place to facilitate it (although few national programmes are open, i.e. provide financial support, to non-UK resident researchers), it boasts a large number of world class research infrastructures and has a strategic plan for their development, research institutions have a high degree of autonomy (although the shortfall of funding for teaching may have negative effects), interaction between the public and private sector are well developed and supported by a broad mix of policies, the outputs of research are well disseminated and moves are underway to further increase access to knowledge and data, and international cooperation with third countries is extremely extensive and supported by a coordinated cross-government strategic approach.

An overall assessment of the policy mix would seem to suggest that a balance is being maintained and that there have been some positive responses to the prevailing macroeconomic uncertainty. One possible issue surrounds the

[1] BIS, Innovation and Research Strategy for Growth, December 2011

absence of key, identifiable actors for the implementation of regional science and innovation policies: it is as yet unclear how the relationship between the TSB's regional remit and the nascent LEPs will be defined and developed.

TABLE OF CONTENTS

Introduction

The UK has the third largest population among the EU Member States, with almost 12.4% (62.4m) of the EU27 total population of 501 million in 2011[2]. In terms of economic performance in 2010 the UK was responsible for 13.9% of the total Gross Domestic Product (GDP) of the EU27 (€12,248b), having a GDP of €1,700b[3]. UK GDP decreased 1.1% in 2008 and 4.4% in 2009, increased 2.1% in 2010 and 2.1% in 2011, and is forecast to increase by 0.7% in 2011 in comparison to the EU27 average GDP increase of 0.3% in 2008, decrease of 4.3% in 2009, increase of 2.0% in 2010 and a forecast 1.6% increase in 2011 respectively[4]. The actual amount spent on R&D (GERD) in 2010 was €30.71b, contributing 12.2% of the aggregate EU27 R&D expenditure of €245b in 2010. This represents a decrease in the share of UK GERD in the total EU27 GERD which was 15.9% in 2006 (Eurostat, 2012). The same source also reported a UK R&D intensity (GERD/GDP) 1.77% in 2010 (1.87% in 2009), which falls just below the estimated EU average of 2.0% for the same year. UK BERD for 2010 was €18.32b, which is slightly up from 2009 (€18.14b) and represents 12.1% of the EU27 of €151.14b. UK GOVERD for 2010 was €2.83b, which is 8.7% of the EU27 GOVERD (€32.6b).

In terms of human resources in science and technology as a share of the total labour force the UK ranks above the EU27 average (45.1% compared with 40.5%) (Eurostat, 2012). As of August 2010, there were 165 HEIs in the UK of which 115 were universities. Despite a shift towards privatisation, a number of Government Departments have retained their intramural research capabilities in some form or other. These institutes and centres are maintained by the Research Councils. Collectively, these form an important component of the science and engineering base, alongside the (much larger) component represented by the University sector. Since 2000, the Government has allocated over €1.5b to the construction of large scientific facilities. Apart from the physical scientific infrastructure, the UK's innovation infrastructure also includes the National Measurement System (NMS), the academic IT network, the UK's intellectual property regime and the UK's standards and accreditation system, plus major initiatives such as the Census of Population Programme.

The UK produces 8% of the world's scientific papers, but of the most widely cited scientific papers, UK authors account for 14%. The majority of these papers (9%) are co-authored with international researchers, which is the highest percentage outside the US[5]. In 2009, the UK ranked 4thamongst the G7 economies in terms of the number of patents granted by the US Patent and Trademark Office, with the total number of patents granted being 8,762[6]. Eurostat figures for 2006 indicate that, with 77.7 patents per million of population, the UK lay below the EU27 average of 106.7[7].

The Department for Business, Innovation and Skills (BIS) plays the lead executive role in research issues, and is the major provider of research funds for the public sector via the Science Budget. This provides funds for the seven Research Councils, each organised on a broad disciplinary basis, which in turn support R&D both in Higher Education Institutes (HEIs) and in their own institutions. Thus, BIS has

[2] Eurostat (2011a) Europe population figures; Available at: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&language=en&pcode=tps00001&tableSelection=1&footnotes=yes&labeling=labels&plugin=1 (Accessed, 9th December 2011)

[3] Eurostat (2011b) Annual National Accounts: GDP and main components. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/data/main_tables (Accessed, 9th December 2011)

[4] Eurostat (2012c) GDP growth rate volume; Percentage change on previous year. Available at: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsieb020

[5] BIS (2011) Innovation and Research Strategy for Growth. December 2011. Available at: http://www.bis.gov.uk/assets/biscore/innovation/docs/e/11-1386-economics-innovation-and-research-strategy-for-growth.pdf (Accessed, 12th December 2011)

[6] BIS (2010a) Annual Innovation Report. Available at: http://www.bis.gov.uk/assets/biscore/innovation/docs/a/11-p188-annual-innovation-report-2010 (Accessed, December 9th 2011)

[7] Eurostat (2010) Europe in Figures: Eurostat yearbook 2010. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-CD-10-220 (Accessed, 8th December 2011)

oversight for the majority of R&D policy formulation, and forms the main author of strategic policies for R&D and innovation, while the Research Councils will develop their specific R&D policies.

The UK government provides support to research and innovation activities in the private sector through a number of mechanisms, including tax credits for R&D investment, and the work of the TSB, which is sponsored by BIS and has responsibility for the formulation and delivery of the Government's technology strategy. Other Ministries and Departments, particularly the Department for Environment, Food and Rural Affairs, the Ministry of Defence and the Department of Health, also have significant research portfolios within their areas of responsibility, and commission R&D through their own laboratories and institutes.

There are no recent major changes in the institutional set-up of the innovation governance system, except for the closure of the Regional Development Agencies, which are to be replaced by Local Economic Partnerships (LEPs) by April 2012. These will be consortia of local authorities which will be responsible for economic development. Furthermore, evidence presented to the House of Lords Committee enquiry on public procurement as a tool for innovation[8] stated that the "TSB will assume the RDAs' functions and will become, in effect, the innovation agency for the UK. It will not be the only public sector agency responsible for innovation, but it will be the only one with a cross-economy, entirely cross-sectorial remit, covering the whole United Kingdom".

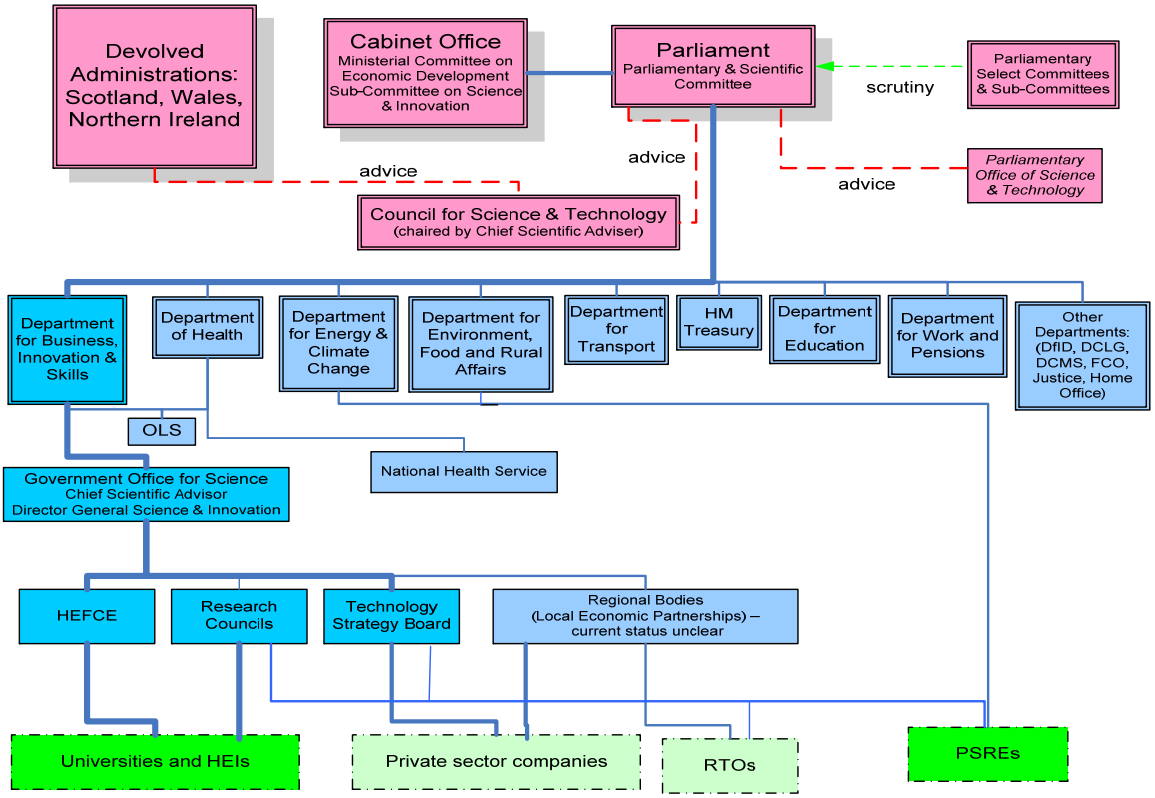
The main actors in the performance of UK public sector research are the HEIs, most of which are universities. The majority of their research funding is provided in the form of grants from the Research Councils, awarded to individual researchers as well as to longer running programmes, units and centres. Other funds, including research funding, in England, Wales and Scotland are provided by BIS through dedicated non-departmental funding councils. In Northern Ireland, funding for research comes directly from the Department for Employment and Learning, Northern Ireland (DELNI) (Cunningham and Karakasidou, 2009).

With regard to R&D in the private sector the R&D Scoreboard in 2010 reports that of the top 1,000 R&D performing firms in the world, 345 of the UK-owned were listed companies (with an R&D spend of €19,924m), 191 were privately owned (R&D spend = €1,717m) and 24 nationally owned (R&D spend = €224m). The remaining 440 were foreign owned and had an R&D spend of €8,303m[9].

Figure 1: The UK R&I system

[8] http://www.publications.parliament.uk/pa/ld201012/ldselect/ldsctech/148/14802.htm

[9] BIS (2010b) R&D Scoreboard 2010; Available at: http://webarchive.nationalarchives.gov.uk/20101208170217/http://www.innovation.gov.uk/rd_scoreboard/?p=3 (Accessed, December 9th 2011)



Key:
DCLG: Department for Communities & Local Government
DCMS: Department for Culture, Media & Sport
DfID: Department for International Development
FCO: Foreign & Commonwealth Office
HEFCE: Higher Education Funding Council
HEIs: Higher Education Institutes
OLS: Office of Life Sciences
PSREs: Public Sector Research Establishments
RTOs: Research & Technology Organisations

Policy Level Bodies
Operational Level Bodies
Research Performers

Structural challenges faced by the national system

As has been mentioned in previous ERAWATCH Country Reports and in the INNO Policy TrendChart reports10, one of the UK's strengths in the area of innovation policy governance is that it is rarely subject to dramatic shifts in priorities, instruments or structures relying instead on a long-term strategic view of innovation policy informed by an extensive process of review (including evaluation). However, as in many countries, the effects of the economic downturn and financial uncertainties (both global and those deriving from the problems of the Eurozone) have significantly impacted the economic performance of the country which has resulted in a number of impacts on a range of innovation indicators (or their proxies). Clearly, this will pose a challenge to the maintenance of this stable policy governance approach.

According to the 2010 Innovation Union (IU) Scoreboard11, based on a composite indicator derived from 25 IU Scoreboard indicators, the United Kingdom remains one of the group of 'innovation followers' together with Austria, Belgium, France, Ireland, Luxembourg and The Netherlands, all of which show a performance above to the EU27 average. The UK leads this group and is just behind Germany, one of the so-called 'innovation leaders'.

[10] E.g. Malik, K., Cunningham, P.N., and Gagliardi, D. European TrendChart on Innovation: Innovation Policy Progress Report: United Kingdom 2008-2009, Published under the Innovation/SMEs Programme, European Commission, Directorate General for Enterprise, November 2009.
[11] http://www.proinno-europe.eu/inno-metrics/page/innovation-union-scoreboard-2010

However, in terms of growth, the IU Scoreboard lists the UK as a 'slow grower' with an average annual growth in innovation performance of about 0.8%. Over the period 2000-2009, the *Innovation Union Competitiveness Report 2011* (IUCR) notes that the UK showed relatively higher growth in the following innovation-related indices: Employment in knowledge intensive activities as % of total employment; Public expenditure on R&D as % of GDP; New doctoral graduates (ISCED 6) per thousand population aged 25-34; International scientific co-publications per million population; and Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications of the country. Moderate growth was observed in: GERD as % of GDP; Researchers (FTE) per thousand labour force; and Licence and patent revenues from abroad as % of GDP. Low growth was seen in BERD as % of GDP; PCT patent applications in societal challenges per billion GDP (PPS€); and PCT patent applications per billion GDP (PPS€).

The country rankings for each innovation dimension presented in the IU Scoreboard show that the UK had the following rankings: Human Resources – 4th; Open, excellent and attractive research systems – 4th; Finance and support – 4th; Firm Investments – 8th; Linkages & entrepreneurship – 4th; Intellectual assets – 12th; Innovators – 19th; and Economic effects – 7th.

These findings would broadly tend to suggest that the UK has a relatively strong S&T research system but that this is not matched by business innovation performance. The IUCR 2011 attributes this strength to a number of world-class universities, a large share of young doctoral graduates and competitive strengths in some high-tech and medium-high tech sectors such as pharmaceuticals.

The IUCR 2011 notes that R&D intensity in the UK has averaged around 1.8% (1.87% in 2009) while the UK Innovation Survey 2009 (BIS/NESTA, 2010)[12] states that overall total R&D intensity has remained broadly stable at around 1.9% of GDP from 1997 to 2008 and that it has remained below that in many major developed economies. Official UK figures[13] (2010) show that in 2009, UK GERD was £25.9b (approx. €30.1b). Although this represented an increase, in cash terms, of 0.4% from the level recorded in 2008, in real terms, GERD decreased by 1.2% between 2008 and 2009. Overall government investment in R&D, incorporating the science budget, higher education funding councils and direct government expenditure on R&D was valued at over £9.4b (€11b) in 2008/09.

It should be noted that much of the data on which these indicators and assessments are based does not reflect the potential effects of the economic downturn which began in 2008, which might be expected to have a greater impact, at least in the short term, on the private sector.

Other key findings in the 2009 UK Innovation Survey include the fact that business R&D intensity in the UK has also failed to keep up with competitor nations: between 2008 and 2009, business R&D dropped by 2.5% to £15.5b (€18.5b), although it remained stable at just over 1% of GDP. However, as recognised in the IUCR 2011, the sectoral mix of the UK's economic structure may account for some of this discrepancy (services contribute around 76% of the UK's GDP[14]) – adjusting for this reduces the UK's investment intensity gap to 0.25% GDP as compared to Germany and 0.5% compared to France. Thus, although continued underinvestment may compromise the future scientific and technological competitiveness of the UK, it must be noted that the picture of its innovation investment is only partial. Nevertheless, since the UK services sector is dominated by banking, insurance and business services – all of which have been negatively impacted by the economic downturn and other exogenous factors, there is little room for complacency.

Thus, it is worth noting that nominal investments in intangible assets have risen 4.6% per year since 2000 to £140b (€165b) in 2008. These account for 14% of private sector output. Innovation has accounted for 63% of the UK's annual labour productivity growth since 2000, with investments in intangibles accounting for 23% of productivity growth. Investment in intangibles in 2008 also helped reduce the negative impact on productivity of the start of the recession (BIS/NESTA 2010).

[12] BIS, NESTA, *2010 Annual Innovation Report*, January 2011

[13] Office of National Statistics: http://www.ons.gov.uk/ons/rel/rdit1/gross-domestic-expenditure-on-research-and-development/2009/index.html

[14] http://www.economywatch.com/world_economy/united-kingdom/uk-economic-indicators.html

Turnover for UK businesses from innovation products increased from less than 8.5% in 2006 to 10.5% in 2008, although these figures pre-date the full effects of the financial downturn. Another impact of the financial instability, and of particular concern with regard to the growth and survival of high-tech SMEs, was the continuation of a worrying decline in venture capital investment from €1.53b in 2008 to €782m in 2009 (ibid.).

On a more positive note, the UK has seen a strong increase in science and technology human resources from 37% of the labour force in 2001 to 44% in 2009 (ibid.). However, the implications of the introduction of full student fees of up to £9,000 (€10,300) per year by the majority of UK universities (although students in Wales and Scotland do not have to pay fees if attending home country universities) are as yet unknown: numbers of UK applicants for 2012[15], the first year in which full fees will be charged, have dropped by 12%, while those from EU applicants have fallen by over 9% (UCAS, 2012)[16]. The increase generally represents a trebling of the previous level of fees.

As an indicator of the translation of the results of publicly-funded research, the 2010 Annual Innovation Report notes that university knowledge exchange income, which was valued at over £3b (€3.6b) in 2008/09, increased by 6% per year between 2003/04 and 2008/09. This area has formed and continues to represent a major area of policy focus with a number of inter-sectoral collaboration and mobility schemes in operation.

At the macro-economic level, very recent (16/11/2011) figures from the Office for National Statistics indicate that total unemployment in the UK was 2.62 million in the three months to September 2011, the highest since 1994. Unemployment among young people exceeded one million, prompting media warnings of a “lost generation” of young Britons. The number of women without jobs also hit one million, the highest level since 1988.

- In summary, the above indicators and priorities tend to suggest that the main structural challenges facing the UK tend to remain largely unchanged from previous years’ analyses. These are:
- A continuing low level of private sector R&D investment, in all sectors of the economy;
- The need to maintain a continuing policy focus on the translation of the results of publicly supported R&D into commercial products, process and services;
- In the face of continuing economic pressures the need to maintain the present level of public funding of the science base (despite ring fencing over the next 3 years);
- Uncertainties over the future supply of human resources in S&T (in the face of university teaching cuts and the introduction of higher student fees);
- Pressure on the supply of venture capital for the growth and development of SMEs and start-ups.

Assessment of the national innovation strategy

National research and innovation priorities

As reported in the 2011 TrendChart mini-Country Report for the UK[17], shortly after being elected in May 2010, the Conservative/Liberal Democratic coalition government, faced with the global economic crisis and public debt issued an Emergency Budget, subsequently followed by a Comprehensive Spending Review (CSR) which resulted in a number of severe cuts (austerity measures) in departmental budgets in

[15] Based on numbers of applications received by universities by 15 October (deadline for Oxford, Cambridge and courses in medicine, dentistry and veterinary medicine) which form an early indicator of the total across all courses this year

[16] Universities and Colleges Admissions Service (accessed 17/11/2011): http://www.ucas.com/about_us/media_enquiries/media_releases/2011/20111024

[17] Cunningham, P.N., Sveinsdottir, T. and Gok, A. Mini-Country Report/United Kingdom. Thematic Report, ERAWATCH Network, July 2011.

order to drastically reduce the scale of public spending. Despite the cuts, the Science Budget was preserved at around €5.6b in cash terms for the life of the current Parliament, although university budgets, excluding research, were cut by 40%. Welfare funding was particularly hard hit, although health spending was ring-fenced and international aid expenditure increased.

Recent policy documents include a 2010 edition of the BIS Annual Innovation Report (January 2011) and the Science Budget figures (December 2010). In the absence of any more recently published broad strategy papers, the Science and Innovation Investment Framework (SIIF) 2004-2014 continues to provide a long-term policy context for the prioritisation of expenditure on S&T. The most recent document was a new strategy for innovation, published in autumn 2011. This *Innovation and Research Strategy* (early December 2011) was accompanied by an *Innovation and Research Strategy Economics Paper.* As reported in the 2011 NRP, the Strategy focuses on "how the Government will support innovation activity across the most important sectors of the UK economy, in particular those that offer the greatest scope for boosting growth and productivity".

According to the latest Strategy, there are four priorities for UK innovation policy as identified by the Department for Business, Innovation and Skills (BIS)[18]:

1. Facilitation of collaboration between organisations in the private, public and third sector, from the international to local level, to generate and apply new knowledge and to strengthen the sharing and dissemination of knowledge within the innovation system.
2. The need to maintain and develop a full scale and coherent knowledge infrastructure – the university science system, research labs and organisations, and information agencies working in design, intellectual property, quality assurance and specialist support.
3. Incentivisation of businesses across the economy to make investments into innovation. This includes attention to the innovation performance of the service sector, and of large medium and low tech industries in manufacturing, construction, energy supply, etc, all of which is crucial to the development of the UK economy.
4. Transformation of the public sector into a major driver of innovation whilst recognising that the complexity and culture of the public sector create operational barriers towards this aim.

Details of the specific announcements made in the *Innovation and Research Strategy* are presented in Section 3.4 below.

The SIIF Annual Report 2009 reviewed progress against SIIF's six broad themes (World class research, Responsiveness to the needs of the economy, Business R&D and innovation, Supply of scientists, Public understanding and engagement, Science and innovation across Government), concluding that continued good progress has been made (BIS, 2009). A 2010 edition of the SIIF Annual Report was expected in mid-December 2010, but no update has been published.

The BIS Business Plan is renewed annually. The most recent was published in May 2011 and sets out a number of more specific targets below the broad level objectives that reiterate the general goals of the SIIF 2004-2014. Lastly, the *Plan for Growth* (HM Treasury/BIS, March 2011) set out a number of actions, largely in the context of the ongoing repercussions of the economic recession. While not shifting the balance of innovation support, these do have implications for a number of specific instruments. In November 2011, HM Treasury and BIS published an overview on progress made towards the implementation of the actions outlined in the Plan for Growth[19]. The main developments in terms of innovation-related policies are noted below:

- To stimulate the development of start-ups, a moratorium exempting micro and start-up businesses from new domestic regulation was introduced in April 2011. This is reducing the flow of new domestic regulations on micros and start-ups. On regulation more broadly, the Government has scrapped proposals for specific regulations, potentially saving businesses over

[18] BIS, Innovation and Research Strategy for Growth, December 2011

[19] HM Treasury and Department for Business, Innovation and Skills, The Plan for Growth: Implementation update, 29 November 2011.

€400m a year in their implementation costs, while in November 2011 it announced a significant package of reform to employment law. The Government has also launched an extensive thematic review of business regulation. Since April 2011, the Red Tape Challenge has resulted in the scrapping or simplification of over 50% of domestic regulations reviewed across the first four themes reviewed. Further reviews are under way. A major focus on revising burdensome EU regulations and directives (including the removal of so-called 'gold plating' by UK authorities, has also been launched, with engagement with the European Commission, other EU Member States, UK businesses and business organisations.

- Various forms of support to SMEs have also been affected: A new package of support has been launched by UK Trade and Investment (UKTI) to help SMEs to enter overseas markets. In November 2011 'The National Export Challenge – Exporting for Growth' launched a series of initiatives aimed at SMEs new to exporting. This included support from business intermediaries, a web resource, a new UKTI prize for the best export idea and a 'how to' export guide for professional services companies. Two facilities introduced in response to the financial crisis were made permanent in March 2011: the Letter of Credit Guarantee Scheme and allowance of the Export Credits Guarantees Department's guarantees to be used to raise long-term finance in capital markets for UK exports. Additional support has been made available to exporters, particularly SMEs, including an Export Enterprise Finance Guarantee (ExEFG) (launched in April 2011) which guarantees lenders to facilitate the provision of short-term export finance lines to exporting SMEs.
- Changes have now been made to the increase the Enterprise Investment Scheme rate to 30% and to double the investor limits from April 2012. A new seed investment scheme and simplification and refocusing of existing schemes will take effect from April 2012.
- In the area of Advanced Manufacturing, the University Technical Colleges (UTCs) programme is to be expanded and at least 24 new colleges should be established by 2014. Five UTCs have already been approved, two of which have opened, with a further 14 approved to open between 2012 and 2014. These are also expected to make a significant contribution to vocational skills education. A high value manufacturing Technology and Innovation Centre (TIC[20]) was launched in October 2011 by the TSB as part of its investment of £140m (€163m) investment over the next six years. Nine new university-based EPSRC research centres for innovative manufacturing were launched in March 2011. Each centre will receive five years of funding to retain staff, develop collaborations, carry out feasibility studies, and support up to two research projects. In addition, the Government is to fund a programme of new Manufacturing Fellowships, to be appointed in April 2012. The accelerated launch of the new enhanced Manufacturing Advisory Service (supported by an additional £7m (€8.1m) providing a total of £59.3m (€69m) total support over three years) will see the service in operation from January 2012. In July 2011, details were announced of a £25m (€29m) fund for Higher Apprenticeships Fund as part of a package of additional investment in apprenticeships worth £180m (€209m) to support up to 10,000 Advanced Level and Higher Apprenticeships in sectors such as advanced manufacturing, IT and engineering. Finally, a new bi-annual £1m (€1.2m) Queen Elizabeth Prize for Engineering was announced to celebrate outstanding advances in engineering that have created significant benefit to humanity. The prize will be awarded by the Royal Academy, with the first to be announced in 2013.
- The Government has also announced a focus on support for the life sciences. For example, in October 2011, two NIHR (National Institute for Health Research) Translational Research Partnerships were launched were launched to offer a new way for life sciences companies to collaborate with the UK's leading clinical researchers on early and exploratory development of drugs and other interventions. Also, investment in NIHR Biomedical Research Centres and Units has been increased to £800m (€930m). The TSB will establish a Cell Therapy TIC/Catapult by April 2012. More broadly, a package of measures is being introduced to standardise procurement, assist SMEs in accessing procurement channels and support innovation in

[20] The TICs have now been renamed 'Catapults'

procurement within the NHS (National Health Service). This ties in with the Small Businesses Research Initiative (£10m/€11.6m budget over the next two years) for innovation in healthcare.

- Lastly, £10m (€11.6m) of funding has been announced to accelerate the development of the International Space Innovation Centre (ISIC) jointly by the National Space Technology Programme (NSTP) and TSB to support R&D in the area of space technologies.

Overall, these changes tend to align closely with the Government's longer term priorities in assisting business (particularly SMEs) in coping with the effects of the financial downturn, especially in terms of removing excessive regulation, in addressing skills needs and in supporting key areas of the economy such as manufacturing and the life sciences (the first where a need additional growth has been identified to counter the perceived over reliance on the (financial) services sector and the second where the UK has a recognised strength). As such, the government seems to be following a balanced mix of policy approaches, consistent with the longer term objectives defined in the 2004-2014 SIIF, but with modifications to address the shifting demands thrown up by prevailing economic conditions, in so far as these can be addressed by micro-economic policies.

Trends in R&D funding

In 2010, the UK Higher Education (HE) sector was responsible for €8,191m worth of R&D activities, having a 26.5% share of the total R&D performed in the country and a 13.1% share of the R&D activities performed by the EU27 HE sector. Both of these figures have been decreasing since 2006. This represents 0.50% of the country's GDP, above the 0.48% average of the EU27 (Eurostat, 2012).

The private sector is both a major funder and performer of R&D. Approximately half of the funds for R&D in the UK come from the business enterprise sector (45.1% in 2010), below the EU27 average (54.1% in 2009). Moreover, in 2010, the business sector's expenditure on R&D (BERD) amounted to €18,321m contributing to 61.99% of the UK GERD and to 12.1% of the EU27 R&D performed by the business enterprise sector in 2010 (€151,125m). UK BERD stood at 1.08% of GDP (2010) below the EU27 average of 1.23%. This ratio had been in gradual decline for more than a decade, although it has levelled out and slightly increased in recent years (Eurostat, 2012).

Government sources provide a third of the funds for R&D in the UK (32.1% in 2010), again very close to the EU27 average of 34.9% (2009). Regarding the R&D performed by the government sector, this represented a share of 9.15% (€2,829m) of the total UK GERD in 2010, falling behind the EU27 average of 13.24% for the same year. Both the UK and EU ratios have decreased since 2006 while the decrease in the former was greater than the latter and the EU ratio increased in 2009. However, the intensity of the R&D performed by the government sector (0.17% for 2010) is below that of the EU27 average (0.27% for 2010) (Eurostat, 2012).

Finally, an important characteristic of the UK research system is the relatively significant R&D investment financed from abroad (16.44% in 2010) in comparison to the much lower EU27 average (8.4% in 2009) (Eurostat, 2012).

Table 1: Basic indicators for R&D investments in UK

	2008	2009	2010	EU average 2010
GDP growth rate	-1.1	-4.4	2.1	2,0
GERD as % of GDP	1.77%	1.87%	1.77%	2.0
GERD per capita	526.2	475.2	484.8	490.2
GBAORD (€ million)	11,770	11,049	11,210	92,729.05
GBAORD as % of GDP	0.65%	0.71%	0.66%	0.76

BERD (€ million)	19,962	18,145	18,322	151,125.56
BERD as % of GDP	1.1%	1.16%	1.08%	1.23
GERD financed by abroad as % of total GERD	17.75%	16.63%	16.44%	N/A[21]
R&D performed by HEIs (% of GERD)	26.50%	27.94%	27.23%	24.2
R&D performed by PROs (% of GERD)	9.15%	9.15%	8.00%22	13.2
R&D performed by Business Enterprise sector (as % of GERD)	61.99%	60.4%	60.92%	61.5

The UK has the stated ambition of reaching a ratio of R&D spending to GDP of 2.5% by 2014, aiming to increase the size of the research system relative to the economy as a whole (HM Treasury, 2004). Eurostat reports R&D intensity (GERD/GDP) in the UK of 1.77% in 2010, below the EU average of 2.0% (Eurostat, 2011). The gap between the UK and its main European competitors is primarily due to a lower share of GDP on R&D performed by the business sector. However, according to the 2008 NRP (HM Government, 2008), studies suggest that part of the gap may be due to the sector mix of the economy. In particular, R&D intensive industries account for a smaller share of UK output when compared to other leading EU countries. Additionally, of the innovation expenditure of UK businesses only a small part is spent on R&D. The 2009 NRP (HM Government, 2009) also emphasised the need to specifically support innovation in the services sector, which accounts for 75% of UK GDP and is considered a key driver of productivity and growth.

Funding for the HE sector is delivered through four complementary pathways which, in turn: support the direct costs of research staff engaged in specific basic and strategic research projects and programmes (competitive grants from the Research Councils); provide broader underpinning support to cover the costs of permanent academic staff and research facilities (Higher Education Funding Councils block funding); offer support to upgrade and improve universities' research infrastructure which has suffered as a result of historic under-investment (Research Capital Investment Fund); and provide an incentive for universities to develop their capacity to engage with business and the wider community (Higher Education Innovation Fund).

The Government's Comprehensive Spending Review (CSR), Budget and Pre-Budget reports contribute to the planning process on resource allocation. The previous CSR was published in 2007. This saw the Science Budget increase to almost €4.6b. Support of the Lisbon Strategy remained a UK policy priority for 2007/2013, with 87% of the UK's allocation to be focused on Lisbon-related activities. The most recent CSR, published October 2010, introduced a set of significant austerity measures. The review covers the years between 2010/11 and 2014/15 and outlined a 25% cut from the budget of BIS. In addition, it needs to find annual savings from the Science Budget (excluding research grants) of around €380m by 2014-15, which can be reinvested in research grants. The overall Science Budget was ring-fenced at €5.4b for the life of the Parliament, which although level in cash terms, equates to a real terms loss of 10%. BIS must find further efficiency savings of €190m per year from the research council institutes and universities but it is not clear if this must come in addition to the €380m mentioned above. Capital expenditure will have to be cut by 44% by 2014-15 although certain projects have been protected. Similarly, the Medical Research Council's budget will be increased with inflation and the budget of the Department of Health will increase by 1.3%, with protection for health research spending: dementia research funding will be prioritised.

It is not possible to see any discernible shifts in the overall balance of the innovation policy mix. UK innovation policy is based on a long term strategic view of STI requirements and funding allocations. Thus, while there may be occasional minor adjustments to individual measures and shifts in thematic

[21] 8.4 (2009), 9.04 (2005)

[22] UK Office of national Statistics, 2012: http://www.ons.gov.uk/ons/dcp171778_258505.pdf

priorities (or, at least, in the way that they are funded), the overall picture tends to reflect long term stability. However, the recent economic crisis has precipitated some departmental cut-backs and constraints on funding. A notable casualty (although the Science Budget support was ring-fenced) has been support for HE teaching budgets.

No overall shift in the share of funding borne by different sectors has been seen, although, with the removal of the Regional Development Agencies for England, the responsibility for regional support schemes has been, or is in the process of being, transferred to the Technology Strategy Board.

The UK's National Strategic Reference Framework for Structural Fund programmes 2007-2013 sets out the UK's plans for the investment of some €9.4b of Structural Funds money over the funding period. This comprises €2.6b in Convergence funding, €6.2b in Competitiveness and Employment funding and €0.6b in Cooperation funding for cross-border and trans-national cooperation activities. While amounts vary by region, around 44.7% of Objective 1 (convergence) and 61.1% of Objective 2 (Competitiveness) ERDF support is spent on activities to support or foster innovation.

No major shifts in the modality of support have been seen, although the alterations of both the R&D Tax Credits thresholds are likely to see an increase in the amount of tax offset by the Government. In addition, there seems to have been a slight growth in the use of venture capital and other equity finance schemes which utilise third party investments. An example is the Business Growth Fund (BGF), which was established to help UK SMEs with an annual turnover of around €11.6m to €116m. This is an independent fund of up to €2.9b, backed by five of the UK's main banking groups working in collaboration with the British Bankers' Association. It is not a Government funded initiative although its creation was welcomed by Government. The BGF will provide long-term equity investment of between £2-10m (€2.3-11.5m) per business in return for a minimum 10% equity stake and a seat on the board for a BGF director.

Although the Research Councils operate a number of cross-Council thematic programmes, these are broadly based and focus on socio-economic challenges combining a number of scientific disciplines and technological areas; hence, they cannot be truly considered thematic in the narrow S&T sense.

Public-private partnerships are becoming more significant, particularly in the mobilisation of risk and venture financing, growth capital and other forms of support. In addition, many support measures also seek to attempt to engage industry in co-funding initiatives particularly in those programmes addressing major socio-economic challenges and cross-cutting technology sectors, and especially where the establishment of multi-stakeholder networks is desired.

Evolution and analysis of the policy mixes

An overview of the current policy mix is perhaps best structured along the lines of the challenges outlined in Section 2.

First, the ongoing low level of private sector investment in R&D&I has been an issue identified by a succession of governments. Various policy documents have alluded to this problem and the main instruments addressing it are the R&D Tax credits for large companies and SMEs. These are accompanied by a range of indirect measures such as awareness promotion, prizes, advisory services, etc. In terms of their appropriateness and impact, the focus on tax credit offers business with a demand-led flexible support rather than a cumbersome and confusing range of targeted measures. In addition, tax credits offer a relatively administratively simple instrument for government and avoid issues such as deadweight, market distortion and the need to balance multi-modal interventions. These main instruments are supported by range of lower cost flexible services and awareness raiding initiatives which appear to satisfy a number of business support niches.

The challenge of translating the results of publicly supported R&D into commercial products, process and services has led to the development of an extensive range of long-standing measures. To this has been added new cluster-type measures (such as 'Catapults' and Research and Innovation Campuses) and other incentives, which address a range of actors, through a broad variety of modalities to promote and sustain collaboration for innovation. As might be expected, the complexity of the innovation process which engages a diverse set of actors along its timeline and the periodic assessment of the impact of

government interventions has resulted in the development of a comprehensive set of measures. Evidence suggests that these measures have been successful – indeed the longevity of several of them (albeit subject to some modification) points towards them having received positive appraisals during their lifetime. With regard to the overall policy mix, there has been criticism that the emphasis placed on research quality by the Research Assessment Exercise (RAE) – the mechanism for the allocation of university block funding for research (notably assessed through the production of research publications in 'high impact' journals) and which, in the past, has tended to reward individualistic publication-oriented research activities, has acted in an opposite direction to other policy interventions that seek to reward the increased relevance of research and interaction with business and other potential users of such research. However, whilst retaining the 'gold standard' of research quality, the additional inclusion of 'impact' criteria in the new Research Excellence Framework (REF) should mitigate this tension through rewarding the broader impact of research.

Efforts towards the maintenance of the science and research infrastructure have largely been achieved through the provision of long-term stable funding streams. Support for the science base has been a priority of a succession of administrations (of all political persuasions) since 1993 when the value of research in underpinning innovation and, hence, the broader economy, was fully recognised. Additional support streams for capital equipment and facilities have also been added to the policy mix, initially to offset the erosion of research infrastructures caused by the structure of HE research and more latterly as a more strategic effort to maintain and support infrastructure for research in key priority areas. The recent ring fenced protection of the science base funding appears to offer a continuing stable platform of support although any significant increases in inflation may erode the real value of research funds in the longer term unless further adjustments are made. Nevertheless, despite cutbacks in other government areas, support for science and research seems to be holding despite the continuing series of economic uncertainties.

The next challenge is that of ensuring the future supply of HRST. Here there has been continuing support for research training (through the Research Councils) although universities have seen significant cutbacks in their funding for teaching activities. The shortfall was supposed to be addressed by the increase of the cap on student fees that HEIs could charge, although the full effects of these changes are as yet unclear (since the is the first year in which the new fee ceiling has been applied and initial indications are that there is a decline in the uptake of university places). To some extent prompted by continuing calls for skilled graduates from employers, there has been some increased attention on workplace skills initiatives and reform of the Further Education (FE) sector plus the establishment of University Technical Colleges for students aged 14 to 19 that combine practical and academic studies. Some might argue that further structural change is required and that the emphasis placed on the HE sector as the leading supplier of skilled manpower is inappropriate, since the lack of a strong vocational/technical training sector remains an issue. However, the recent FE reforms may be a step towards addressing some of the problems.

As in many economies, support for SME growth is a further challenge in the UK. The specific tax credits scheme for SMEs provides a major focus of policy support and this is reinforced by a range of more tailored schemes of R&D support which address the specific needs of SMEs. There has also been an increase of policy attention on a range of schemes aimed at mobilising financial support and investment – more recently, these schemes have received even greater attention in response to the need to protect newly created and developing small companies from the effects of the credit crunch. Measures aimed at the creation of start-ups and spin-offs also exist under the broad challenge of increasing the transfer of research results into economic outputs. Overall, SME support is delivered through a multimodal and flexible range of support measures addressing the spectrum of SME needs, which cover all the aspects of SME provision (direct funding, mobilisation of finance, provision of advisory services, etc.) at both national and targeted regional/local levels.

Finally, the challenge of mobilising the significant resources invested by government in the procurement of (high tech) goods and services has focused policy attention on the issue of public procurement in support of innovation and demand led innovation. There are a limited number of schemes, the most significant being the Government-wide SBRI, although some also exist at departmental level – notably in the NHS. The topic continues to attract significant policy debate and there are policy efforts in place to

raise activity in this area. Some evidence of success exists at the level of specific projects, e.g. in NHS run schemes but the main aim is (or should be) to induce behavioural change in government procurement practice at the local level rather than through flagship national level procurement initiatives concerning major infrastructures.

Table 2: Policy mix: recent developments in broad policy areas

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	No major changes Science budget for research frozen (but not cut) Fields selected for additional funding: clean technologies, renewables, agri-food, utilities, biotechnology	+ Long-term strategic vision and plan, backed by implementation targets is seen as a major policy strength + Sustained investment over recent years may protect research system from major economic impacts - Uncertainty of full impact of austerity measures on economy and the knowledge economy.
Innovation policy	No major changes Increase in schemes to mobilise financial support for SMEs Increased focus on procurement as driver for innovation	+ Balanced policy mix – overall seems to perform well - Prolonged credit crunch may seriously impact firms' access to finance - Decline in public spending and size of public sector may have negative impact on procurement policies
Education policy	Major cuts to HEFCE teaching budget Removal of cap on university teaching fees Increased funding for apprenticeships schemes Reform of FE system Introduction of UTCs	- Potential long term negative impact + potentially offsets reductions in public support for HE teaching - May have long term impact on proportion of pupils going into full time HE + may address skills needs of business and industry
Other policies	Abolition of Regional Development Agencies and formation of LEPs Formation of Regional Innovation Campuses and Catapults	- Leaves apparent gap for delivery of regional innovation support – still unclear how regional funding to be distributed + may revitalise cluster type initiatives

Assessment of the policy mix

A more detailed assessment of specific measures and policies, as outlined above, is given in the table below.

Table 3: Assessment of the policy mix

Challenges	Policy measures/actions[23]	Assessment in terms of appropriateness, efficiency and effectiveness
low level of private sector investment in R&D&I	• R&D Tax credits: on-going	• apparently popular measure (over €1.1b claimed in 2010); apparently efficient and effective measure
translation of the results of publicly supported R&D into commercial products, process and services	• plans to establish elite national network of Catapults (€267m between 2011-15)	• measure based on thorough review (Hauser, 2010). Too early to assess efficiency or effectiveness
	• investment of €58m in graphene research hub, €24m in satellite-based sensing services and €209m in to life sciences commercialisation	• based on strategic reviews and designed to capitalise on UK research strengths. Too early to assess.
	• Collaborative R&D (€174m in 2011-12)	• existing measure. Evidence suggests well used and effective.
	• Knowledge Transfer Networks (KTNs): (€17.5m in 2011-12)	• supports 15 KTNs with over 38,000 members through the Connect web platform. Apparently well-used and successful measure.
	• Knowledge Transfer Partnerships (KTPs) (€35m in 2011-12)	• over 1,000 live projects per year – apparently popular and successful longstanding measure. Positively evaluated several times
	• Higher Education Innovation Fund (€174m in 2011-15)	• good uptake, recently revised allocation process.
	• range of IP support services	• addresses potential barriers to commercialisation through improved IP awareness and advice
	• introduction of EU VAT cost-sharing exemption, to avoid VAT costs and encourage university/charity cooperation	• new measure
maintenance of the science and research infrastructure	• protection of the science and research budget 2010-2015 (€23b)	• appropriate measure given financial climate; efficient use of resources given need to maintain system stability; indicators (publications, researchers, etc.) seem to indicate effectiveness.
	• additional €575m of capital investment since 2010	• measure is appropriate; efficiency and effectiveness are ensured through strategic Large Facilities Roadmap which prioritises needs
	• tax breaks worth €174m over 4 years for research & innovation campuses in local Enterprise Zones	• regional measure aimed at improving performance of centres of excellence for business-research innovation activities

[23] Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions[23]	Assessment in terms of appropriateness, efficiency and effectiveness
ensure future supply of HRST	• existing range of research training through Research Councils (incl. CASE awards), move towards delivery through teaching/research clusters and centres of excellence	• addresses both generic and more specific employee skills needs. There is still demand from employers for additional skills sets.
	• continuing review of training and teaching needs addressed by HE funding bodies and research councils	• ensures delivery of appropriately trained researchers into the research base and business
	• support for early career post-doctoral research fellowships through Royal Societies and British Academy	• support for excellent researchers, addresses need to maintain quality as lynch pin of research support
	• increased support for Apprenticeships schemes	• - addresses absence of adequate pathway for lower level technical skills provision
	• future reforms to FE system; introduction of UTCs	• not clear
	• review of university-business links	• will report on measures to improve relevance of university training to business needs
support for SME growth	• R&D Tax credits: increased rate to 200% for SMEs	• based on recent assessment of tax credit; effective and efficient measure
	• Grant for R&D/Smart (approx. €23m in 2011-12)	• long-standing measure – addresses finance market failure, positively evaluated.
	• Business Coaching For Growth	• advisory service: adds further dimension to increase absorptive capacity.
	• Enterprise Capital Funds programme increased by €232m	• addresses decrease in availability of VC due to credit crunch. Too early to assess.
	• Co-Investment Fund support for business angels (€58m)	• supports UK business angels market against economic downturn. Figures suggest co-investment has declined possibly due to downturn
	• reformed investor tax reliefs including Enterprise Investment Scheme and Seed Enterprise Investment Scheme	• stimulates investment support in financial downturn. Too early to assess effects.
	• encouraged five main banks to set up a Business Growth Fund of €2.9b to fund high growth companies	• addresses lack of supply of bank capital support for small companies engendered by credit crunch. Too early to assess uptake
	• Leveraging of ERDF funding for innovation	• channels ERDF support to regional needs through existing measures

Challenges	Policy measures/actions[23]	Assessment in terms of appropriateness, efficiency and effectiveness
	• new innovation voucher scheme to be launched in 2012-13	• based on regional pilots, will focus on areas with low levels of private sector innovation and growth
	• extension of Launchpad: TSB investment to help small businesses finance developing products or services and to leverage in private sector finance. Designed to strengthen clusters through • facilitating cooperation and networking	• tailored to specific local needs. Early examples appear to be successful.
support for public procurement and demand led innovation	Small Business Research Initiative (€5.8m in 2011-2012)	Appropriate to policy goals of investigating potential of demand led innovation from Government. Some examples of success.

- Other recent policy changes include:
- An increase in funding for the Designing Demand initiative (which provides mentoring for SMEs in design applications) to £1.3m (€1.5m) per annum;
- Sector-specific support with specific dedicated funding allocations for the areas of: clean technologies, renewables, agri-food, utilities, and biotechnology.
- NESTA is to establish a UK Prize Centre to run, design and facilitate innovation inducement prizes. This will coordinate various stream of support across Government, the private sector and philanthropic organisations to support, design, run and judge future prizes. Also, BIS and NESTA will co-finance a new UK Prize Fund to run future inducement prizes. It will leverage interest and investment from the private and public sectors, and philanthropic organisations. BIS will contribute €290,000 per annum towards the fund and an additional €116,000 will be made available to co-fund the first prize run by the UK Prize Centre.

National policy and the European perspective

Table 4: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	Labour Market for Researchers	No real challenges – UK performs well in attracting overseas researchers and students.	Changes to visa tier system to allow entrepreneurs and highly skilled immigration
2	Cross-border cooperation	UK performs very well in European programmes in terms of participation and coordination roles. However, few programmes are open to non-UK residents and there is some non-alignment with EU priority research areas. No serious challenges exist, however.	Some moves towards investigation of the potential for opening up some science-industry collaboration programmes

	ERA dimension	Main challenges at national level	Recent policy changes
3	World class research infrastructures	UK has its own Large Facilities Roadmap which informs spending allocations for large scale infrastructures. Significant funding streams have been maintained: no real challenges.	No major changes made to Large Facilities Roadmap. Significant investments in three major new research facilities announced.
4	Research institutions	Universities enjoy high degree of autonomy. Cuts to teaching funding may not be offset by increase in student tuition fees cap – several universities likely to face shortfall in income from domestic student income.	Raising of cap on student tuition fees. New Research Excellence Framework being developed – will include criteria to assess and reward impact of research in addition to high quality.
5	Public-private partnerships	Longstanding policy goal to increase the extent to which research results are translated into commercial goods and services. Addressed by variety of measures.	Introduction of new Research and Innovation Campuses to facilitate science-industry interaction and the development of clusters. Review of IP regulations to remove barriers to commercialisation and to facilitate research cooperation.
6	Knowledge circulation across Europe	UK has very open research system – no identified challenges.	Research Councils and HEFCE support for open access publishing. Planned establishment of Open Data Institute to facilitate broader use of public domain data.
7	International Cooperation	UK cooperates with range of partner countries. Overall guidance and coordination across government is provided by GSIF. No major challenges.	Priority countries include China, India, Brazil and Indonesia amongst others.

Annex: Alignment of national policies with ERA pillars / objectives

1. Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers

1.1 Supply of human resources for research

According to Eurostat data[24], the proportion of human resources in science and technology as a share of the UK labour force is above the EU-27 average and has risen almost constantly since 2006 (with a slight decline in 2008) – see below:

Table 5: Proportion of human resources in science and technology as a share of the UK labour force

	2006	2007	2008	2009	2010
EU (27 countries)	38.6	39.2	39.6	40.1	40.5
United Kingdom	42.5	43.3	42.7	44.4	45.1

Similarly, despite a slight dip in 2008, the number of graduates has also risen steadily since 2006.

Table 6: Number of graduates

Graduates in ISCED 5 and 6 by age and sex [educ_grad4]	2006	2007	2008	2009
United Kingdom	16,516	17,545	16,606	17,651

Higher Education Statistics Agency (HESA) data indicate that on 1 December 2009 there were 387,430 staff employed in the UK HE sector, showing an increase of 1% from 1 December 2008. 181,595 (46.9%) were academic professionals compared to 179,040 (46.8%) in 2008. 253,970 staff was employed on full-time contracts (252,520 in 2008) and 133,460 on part-time contracts (130,240 in 2008). In 2009, 120,225 (66.2%) of academic staff were employed on open-ended or permanent contracts compared to 115,945 (64.8%) in 2008; 33.8% were employed on fixed term contracts in 2009 compared to 35.2% in the previous year.

Since the UK system views all levels of foreign scholars and researchers as key elements for its success, it offers relatively open and transparent recruitment procedures and equal rights for national and foreign researchers and academics. Current UK research and innovation strategies and policies clearly reflect the willingness of the UK to preserve an open and flexible science base. As the 2008 NRP (HM Government, 2008) clearly states, the UK supports the objectives of the Bologna and Ljubljana processes and welcomes their focus on researcher mobility and careers issues.

Generally, the UK performs well in terms of inward student and graduate mobility, attracting a high number of foreign-born students, particularly in terms of their participation in advanced research programmes. In 2009/10, over half (55.8%) of all full-time and 13.4% of part-time postgraduate students were non-UK domiciled, while the proportion of full-time undergraduate students from outside the UK was 12.97% (and 0.05% of part-time undergraduates) (HESA, 2011[25]). The majority of non-UK students are

[24] http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsc00025&language=en

[25] Higher Education Statistics Agency (accessed 6/12/2011): http://www.hesa.ac.uk/dox/pressOffice/sfr153/SFR153_table_1.pdf

from Asia (42%) followed by other EU countries (31%). According to UNESCO data[26], the UK accounted for 28.12% of the EU mobile student market in 2009, up from 27.36% in 2002. Data from Universities UK indicates that 40% of UK research staff are non-UK nationals (Universities UK, 2008). Non-EU nationals made up 11.4% (19,306) of the total number of academic staff (169,397) at UK HEIs in 2008/09. The largest number of non-EU academic staff was in Clinical Medicine (11.6% of all non-EU academic staff), Social studies (9.8%) and Business and Management Studies (8.2%). The academic subject areas with the highest number of non-EU nationals as a proportion of total academic staff in those areas were Engineering (various types of engineering), Mathematics, Chemistry and Physics. In 2008/09 the country of origin of the largest number of non-EU academic staff was the USA (3,023 of all non-EU academic staff) followed by China (2,770), India (1,717) and Australia (1,416)[27].

High numbers of highly qualified UK-educated people are resident in other OECD countries. This reflects the quality and attractiveness of the UK education system but also implies an outward flow of high-level human resources.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed

The UK HE sector supports the objectives and action lines of the Bologna Process and has been engaged in all related activities. A Europe Unit survey of UK HEIs' European activity in 2005 indicated that one third of respondents already issue the Diploma Supplement, a key Bologna requirement, and 50% planned to do so in 2006 or 2007.

A UK sector-wide expert group led by Universities UK and RCUK (2005) carried out a mapping exercise to identify areas where the UK does not align with the Charter and Code recommendations. This revealed that in most cases the UK already meets the requirements through initiatives such as the QAA Code of Practice, the Research Careers Initiative, the Concordat on CRS Career Management and the implementation of the Roberts' Report recommendations in 'SET for success'. The Concordat to Support the Career Development of Researchers sets out the expectations and responsibilities of researchers, their managers, employers and funders. It has been signed by all the major UK HE sector stakeholders and aims to increase the attractiveness and sustainability of research careers in the UK and improve the quantity, quality and impact of research for the benefit of UK society and economy.

Thus, no major conflicts with existing practices in the UK or barriers for HEIs wishing to adopt the European Charter and Code were identified. However, some needs for clarification were highlighted (considered as part of the updating of the UK's Researchers Concordat). Also recommendations were offered to HEIs wishing to formally adopt the European Charter and Code. On the whole, the UK HE sector supports the voluntary status of these documents as instruments to support reform across Europe, even though moves to link the Charter and Code with a label or seal or to funding are unwelcome by the HE sector. UK HEIs are encouraged to engage with the principles in the Charter and Code through the intergovernmental Bologna Process. Currently, the EURAXESS website provides the text of the UK Research Concordat as its entry for the UK.

Remuneration policies: The contracts of academics and researchers in the UK HE sector are usually tenured compared to the more permanent contracts offered by the government sector. However, the freedom offered to the researchers to perform their tasks, the high quality infrastructure and research outputs make the UK an attractive destination for researchers. Moreover, UK HE salary levels are among the highest in Europe, even though they still lag behind the US. Although entry level salaries are relatively low, the high rate of increase that the researchers experience throughout their career via promotions, contribute to the attractiveness of the UK research system.

[26] Sourced by the UK Higher Education International Unit: http://international.ac.uk/resources/InternationalHigherEdFactsFigures2011WEB.pdf

[27] Universities UK press release: http://www.universitiesuk.ac.uk/Newsroom/Media-Releases/Pages/UniversitiesUKresponsetoHomeAffairsCommitteereportonimmigrationcap.aspx

According to an EC report the average total annual salary of a researcher in the UK was €56,048 in 2006, exceeding the EU25 average of €37,948, placing the UK among the highest paying countries for researchers. However, when considering the cost of living, the position of the UK deteriorates with the average salary decreasing to €52,776, while the average EU25 salary improves to €40,126. Nevertheless, this still keeps the UK in the range of countries with high remuneration level (€40,000-60,000).

Another characteristic of the UK system is that despite low entry point salaries, researchers can expect a significant increase in remuneration throughout their careers - a powerful incentive. The UK ranks thirteenth among the EU25 and Associated Countries based on the salary of younger researchers (0-4 years' experience), but rises to sixth based on the remuneration of experienced researchers (>15 years in the research profession). This increase represents an increment of 235.42% during the researcher's career. Salaries are independently determined by UK HEIs, based on market demand and supply, competition, and on their strategies and available resources. Although there are overall guidelines for pay, mediated by a number of academic staff unions, UK universities are autonomous in the determination of academic and research pay scales and employment conditions. Remuneration and employment conditions for both national and foreign members of staff are controlled by the same regulations, with most universities operating equality and diversity policies offering equal opportunities for all members of staff.

Generally, existing UK employment law, especially its anti-discrimination legislation, and sector-specific guidance such as that of the Joint Negotiating Committee for HE Staff (JNCHES) on work-life balance, allows the UK to fulfil and in some cases exceed the European Charter and Code's requirements. The gap analysis also recognised that many UK HEIs "will also have their own internal policies that will cover many aspects of the European Charter and Code, although it is unlikely that every aspect is addressed in a single document" (Universities UK and RCUK, 2005). For non-EU applicants, the UK currently operates a five-tier points based system under which points are awarded for different attributes (qualifications, age, English language skills, etc.). The points required depend under which tier the application is made and may permit residence with or without a UK sponsor (generally an employer or educational institution) (British Council, 2010). Individual UK institutions already provide practical assistance through international offices to foreign researchers wishing to relocate to the UK for a period of work.

Research grants awarded to UK resident researchers are generally transferable to other UK institutions with the individual awarded although some restrictions may apply depending on specific circumstances. Transferability to institutions outside the UK is generally much more restricted but Individual UK Research Councils have bilateral arrangements which allow for grant portability with specific partner research funding bodies both within Europe and beyond (British Council, 2009).

1.3 Improve young people's scientific education and increase interest in research careers

The SIIF 2004-2014 has among its targets "a strong supply of scientists, engineers and technologists" including achieving a step change in the proportion of minority ethnic and women participants in higher education. In this context, UK has introduced several policies to enhance the attractiveness of STEM education and research careers. For example, to address the issue of strategically important research areas that have been identified as 'at risk', the Government's Science and Innovation Awards scheme provides large, long-term grants (typically €5-8m over 5 years) to support staff in research groups, on the condition that the host institute continues to provide support at the end of the grant. These awards are funded jointly by the EPSRC, and the Higher Education funding bodies in England, Wales, Northern Ireland and Scotland. Vocational training on the other hand is somewhat less well supported and has been somewhat marginalised as recent governments have emphasised the need for more young people to acquire university qualifications. However, more recently, there has been increasing policy emphasis on the importance of apprenticeships with the introduction of particular support schemes (se Section 3.1).

The issues of creativity, critical thinking, problem solving, teamwork and communications skills certainly provide a topic of debate in the development of HE curricula. At the school level one must distinguish between the National Curriculum (operated in England) and the wider school curriculum. Originally, the National Curriculum was envisaged as a guide to study in key subjects. However, the National

Curriculum has come to cover more subjects, prescribe more outcomes and take up more school time than originally intended. With the intention of slimming down the National Curriculum in order that it balances the need to cover essential knowledge while not over-burdening teaching time in schools, the Government launched a review of the National Curriculum in November 2011. Individual schools will be given "greater freedom to construct their own programmes of study in subjects outside the National Curriculum and develop approaches to learning and study which complement it". In this context, there is extensive evidence of debate among professional teaching bodies on the importance of the above broader skills set and of ways in which it can be taught.

1.4 Promote equal treatment for women and men in research

Promotion of women: Based on Eurostat data presented in the "She Figures 2006" report (EC, 2006) in 2003, 42% of UK PhD graduates were female, below the EU25 average of 43%. However the growth rate of female PhD graduates in the UK between the years 1999-2003 was double that of male PhD graduates (10% versus 5%), and above the EU27 average (7%, females and 2%, males). Similarly, the proportion of female researchers in 2003 was 43% in the UK HE sector and 32% in the Government sector compared to the EU-25 average of 35% for each sector. The growth rates for the two sectors are also higher for female researchers.

The UK Resource Centre for Women in SET (UKRC) also assists women to return to or progress in their SET careers and builds links with companies, advising and supporting on recruitment, retention and progression best practices for women scientists and engineers. According to the UKRC, women are still under-represented in SET in the UK:

- In 2008, nearly 13,000,000 women were working in the UK - of these, only 5.3% were in SET occupations: of 15,400,000 men in employment in 2008, a third worked in SET.
- Women represent 15.5% of SET professionals in the UK.
- Of 5,497,072 people working in SET occupations (including skilled trades) in the UK in 2008, only 12.3% were women.
- Among 468,580 engineering professionals, only 6.9% were women (32,106); Among 457,636 ICT professionals, only 14.4% were women (66,076).
- In 2008 women accounted for only 5.2% of SET-based self-employment in the UK
- In 2007-2008, women made up 33.4% of all HE students in STEM disciplines and in June 2009 they made up 42.2% of GCE A level students in STEM subjects; thus, women are being lost to STEM at key transition points.

The UK's ten-year SIIF aims amongst others to achieve a step change in women's' participation in higher education, placing strategic emphasis on the matter. In this frame, several initiatives have been introduced to support women's' participation in STEM education, research and professions, such as the Women into Science and Engineering (WISE) scheme, which collaborates with industry and the education sector, provides advice to policy-makers and assists in the delivery of relevant actions. Initiatives undertaken by the scheme contributed to the doubling of female engineering graduates from 7% in 1984 to 15% in 2008.

2. Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding

Leaving aside the willingness to participate in joint programming exercises such as ERA-NETS, at the national level research programmes in the UK are predominantly not open to foreign participation, although there may be mechanisms by which such participation may be accomplished, albeit on a very low level. For example, eligibility criteria for UK Research Council funding are restricted to UK HEIs and Independent Research Organisations (IROs) only. Similarly, for the competitions run by the TSB, the conditions state that "a key aim of the TSB's support is to help improve the UK's innovation performance. Collaborators outside the UK - EU and non EU - are acceptable, but there must be a clear and substantial gain for the UK brought about by their involvement". There have been indications that

international activities are a developing area for the TSB, which is looking at integrating international thinking into all of its activities. One particular aim was that of strengthening the international role of the KTNs and looking at providing support for international KTPs. However, since reporting these developments in the previous (2010) country report, no significant evidence of progress towards these objectives can be found.

Thus, overall it appears that, with regard to the major streams of national R&D funding, the research costs of non-UK nationals are not supported and UK programmes have not been opened up to foreign participation. The Collaborative R&D programme, which forms part of the Technology Programme operated by the TSB, may be used by UK applicants to fund their share of the participation costs for Eureka. However, funding for non-UK nationals is not available. In fact, a criticism of UK industry support schemes is that larger companies wishing to participate in Eureka must apply via the Collaborative R&D scheme, whilst SMEs with the same ambition must apply via the Grant for R&D scheme, i.e. via two separate pathways run by separate agencies. One further recent exception is the participation of the UK Research Councils in the Money Follows Researcher scheme operated through EUROHORCS.

Typical barriers to the opening up of national R&D programmes to overseas participants include matching co-funding and the issue of double jeopardy (i.e. the need to ensure complementarity and agreement between differing peer review mechanisms and processes), whilst for collaborations with industry, issues such as IPR and differing legal regimes are also significant hindrances.

3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them

Generally, the UK recognises at strategic level that investment in world-class infrastructure is a pre-requisite for world-class research. Thus, a key commitment in the SIIF 2004-2014 is to ensure access for UK researchers to leading edge facilities either in the UK or abroad. It hosts a large number of national and international research facilities and is also involved in many facilities in Europe and the rest of the world (DIUS, 2008d), including the Diamond Light Source in Harwell, ISIS at the Rutherford Appleton Laboratory, the Laboratory of Molecular Biology (LMB) in Cambridge, the Large Electron Positron Collider (LEP) in the French/Swiss border, the Cassini-Huygens Mission to Saturn and many more.

Funding for large facilities and infrastructure in the UK is available from the Research Councils, Government Departments, Devolved Administrations, non-profit organisations (charities), private sources, the European Commission and international bodies. In addition, the Government has a specific funding stream, the Large Facilities Capital Fund (LFCF) which allocates, on average around £100m (€116m) per year “to support the Research Councils' investments in large research facilities and infrastructure with capital funding that could not be accommodated from within Research Council budgets. LFCF allocations to large facilities are agreed with Government biennially and provide a funding contribution to the capital costs of: the construction of new facilities either nationally or internationally; the expansion or enhancement of existing facilities; and the upgrading or replacement of existing facilities”. Eligible facilities for LFCF funding must be included in the RCUK Large Facilities Roadmap (see below) and must satisfy a number of criteria (e.g. they must represent a large scale investment in research infrastructure – with total capital costs of more than £25m (€29m) or over 10% of the annual budget of the lead Research Council.

The Research Councils are jointly responsible for the production of a Large Facilities Roadmap. This is intended to “provide UK policy makers and researchers with a comprehensive picture of the new facilities which are already under construction in the UK or internationally, and provides details of potential large facility and infrastructure projects that UK researchers would like to see available over the next 10-15 years”. The latest version of the Roadmap was produced in 2010. The RCUK Large Facilities Roadmap 2010 does not seek to be fully comprehensive but focuses on projects identified by the Research Councils, following consultation with their communities, as being of the highest strategic importance. Large Facilities Capital Funds have been allocated to the following projects: MRC Laboratory of Molecular Biology (LMB II), Institute of Animal Health – Pirbright, Replacement for RRS Discovery and Provision for High Performance Computing.

The Research Councils also support infrastructures through the provision of equipment funding. Moreover, a number of the Councils have their own institutes with research laboratories and are responsible for maintaining their infrastructure. Research Councils support the provision of access to leading edge international experimental facilities, often through international subscriptions or joint funding. The Research Councils are responsible for funding major international subscriptions or brokering bilateral arrangements to enable UK researchers to use such facilities. The Science and Technology Facilities Council (STFC) has a particularly active role in facilitating such arrangements. The STFC was expected to invest €674m in 2010-2011. Access to most UK facilities is open to EU researchers, although specific conditions may apply according to the facility in question.

Apart from the physical scientific infrastructure, the UK's innovation infrastructure also includes the National Measurement System (NMS), the academic IT network, the UK's intellectual property regime and the UK's standards and accreditation system, plus major initiatives such as the Census of Population Programme.

A Government 'Strategic Vision for UK e-Infrastructure' is to be published shortly.

4. Strengthen research institutions, including notably universities

UK universities are autonomous bodies, with charitable status. Universities are academically completely autonomous. They are also free to seek funding from a variety of sources and to allocate it internally according to their own institutional needs. They are also completely independent in their recruitment policies, for all university positions. As a consequence of this autonomy, no significant changes have emerged over the last three years although policy developments have impacted on the broader notion of autonomy. For example, following from the findings of the Browne Review of university tuition fees, the Government decided in 2010 to lift the cap to £9,000 (€10,500) annually as of 2012. A condition was that universities who wished to raise their fees above £6,000 (€7,000) would have to put in place measures ('Access agreements') to ensure that access to university places remained open and that students from poorer economic backgrounds would not be disadvantaged (for example, through the greater provision of bursaries). Such conditions implied greater costs to the universities and are seen by some as a challenge to university autonomy.

In recent years, greater emphasis has been placed on the 'Third Mission' of universities, i.e. greater engagement with businesses and local communities. To this end, the Higher Education Investment Fund represents the main policy stimulus, although HEIs individually and collectively engage in a variety of 'outreach' activities and several regional and trans-regional consortia have been set up to address this activity. In addition, several sources of funding – some of which are quite long-lived - are in place to stimulate interaction with the business sector. No significant changes have been made at the national level over the last three years.

The UK Research Assessment Exercise (RAE) is the mechanism whereby university block funding for the support of research (i.e. to meet infrastructural costs, etc.) was formerly allocated. After some 22 years, the government announced in 2007 that would replace the RAE with a Research Excellence Framework (REF) which will be based on a mix of panel review, bibliometrics and other indicators - depending on the subject area under consideration. A novelty in the REF will be the inclusion of 'impact cases' – individual, evidence-based examples of research activity that has led to wider impacts beyond the academic community. The move was prompted by growing dissatisfaction with the former RAE and also based on claims that it had achieved its original purpose - to drive up the quality of research performed in UK universities. Currently, HEFCE is consulting and commissioning studies on the precise form that the REF will take and the final process is due to be completed in 2014, in order to inform funding decisions in 2015-16.

The allocation of funds for research (the so-called QR element) is based on a formula which takes account of the academic rating and the number of staff entered to the exercise (the volume driver). Universities are free to allocate this stream of funding internally in any way that meets their strategic research needs. HEFCE and the other UK Higher Education funding agencies have produced a report on the impact of the block grant funding system.

5. Facilitate partnerships and productive interactions between research institutions and the private sector

The recent Innovation and Research Strategy for Growth (BIS, 2011) notes "[UK] universities' knowledge-based services to business and other partners are now valued at over £3b [€3.5b] and have been growing at 4% per annum in recent years. In 2009-10, university spin-off businesses based on leading edge research from UK universities turned over nearly £1.8b [€2.0b] and employed around 17,000 people".

The issue of knowledge transfer from the research base to business has formed a policy priority for some time in the UK. Several government initiatives exist to facilitate this process (HEIF, KTNs, KTPs, CASE awards) all of which provide funding according to various criteria to stimulate collaborative research and inter-sectoral mobility. In general, the mobility of researchers between sectors (i.e. between universities and firms) is supported and often actively encouraged through a number of schemes and initiatives. Accordingly, the administrative barriers to such mobility are minimised wherever possible. Specific arrangements for staff mobility are likely to vary according to individual HEIs and PSREs (Public Sector Research Establishments).

In addition, several, well-established initiatives are in place to support and promote the creation of university and public-sector spin-out companies. Support comes from a range of sources: government schemes to develop and encourage the provision of venture and seed capital streams, regional grants and initiatives to assist in the set up of incubators and similar initiatives and institutionally-based forms of support for science and technology parks, incubators and enterprise centres (some of which specifically target the formation of graduate spin-out companies).

At the institutional level, all major UK HEIs and Public Sector Research Establishments (PSREs) tend to have in-house mechanisms to promote the transfer of knowledge to business (including SMEs) and to promote links with nearby communities. These range from science and technology parks, incubator facilities, knowledge transfer offices, industrial liaison units and similar types of initiative through to web-based access portals. The development of such mechanisms has been supported both by external funding (such as initiatives like HEIF) and from internal intuitional funds, since knowledge transfer activities form an important source of income for HEIs and PSREs (in 2008, Research Council institutes generated €164m from the commercialisation of their research).

Another development is that of Research and Innovation Campuses at various locations across the UK. These provide an environment in which for businesses, industry, universities and researchers can interact at a variety of levels to generate innovation and deliver impact from research investment. Areas of focus include life sciences and biomedical research, energy, security, climate and the environment. They offer access to advanced world-leading facilities, scientific services, training environments and world-leading expertise. Current campuses include: Harwell Science and Innovation Campus (Harwell, Oxford), Babraham Research Campus (Cambridge), Norwich Research Park and Daresbury Science and Innovation Campus (Cheshire).

The UK Intellectual Property Office plays a central role in raising awareness on IP issues in both the public and private sector and is involved in several knowledge transfer schemes as an, often proactive, information source. The Lambert tool-kit for collaborative research (a set of guidelines for IP issues) seems to align closely with the principles of the EU's Code of Practice for universities and public research organisations, which it pre-dates. The tool-kit was expanded in 2009 to include a new set of consortium agreements designed for technology collaborations involving several academic and industry partners. The Business-to-Business licensing advice programme launched an extended set of new materials in December 2009 on IP valuation and confidentiality, important for approaching issues about IP arising from research.

Business representatives (particularly local ones) frequently sit as members on governing bodies such as university councils and the equivalent bodies in PSREs and such active participation in the running of HEIs and PSREs is encouraged in order to ensure alignment to the needs of the business sector, where relevant. The employers' association, the Confederation of British Industry, has called on the business community to offer relevant work experience, and where appropriate, work with universities to develop

courses that lead to attractive employment for graduates. A review of university and business links is examining these issues and is due to report in early 2012.

6. Enhance knowledge circulation across Europe and beyond

The general UK view is that collaboration in R&D with researchers within the EU (and Associated Countries) can be adequately addressed and coordinated within the existing set of frameworks, (e.g. FP, Eureka, ERA-Nets, CERN, etc.) and that these provide a sufficiently rich and diverse set of opportunities for intra-EU R&D cooperation, without the need for further mechanisms. Thus, much of the support for collaborative R&D activities tend to focus on support for mobility (especially for young UK researchers, or for young, high quality or more senior eminent foreign researchers) in order to facilitate the interchange of ideas to the UK science base and to disseminate the influence of UK science abroad. Much of the collaborative R&D in which UK researchers are involved is guided through a bottom-up responsive mode process, either on the basis of individual researchers or research groups or through the collaborative arrangements and agreements established by UK universities. In addition, the UK engages in a number of collaborative international R&D programmes, which are generally managed by the Research Councils, and UK researchers make extensive use of international research facilities.

The UK government is highly supportive of national participation in EU initiatives. According to Technopolis (2010), UK research priorities match well with those of the current Framework Programme, although “the analysis suggests that some UK research priorities are a better match with the Framework Programme than others, current UK interests in e.g., energy or nanoscience are a more direct and expansive fit with FP7 than is the digital economy or high-value services”.

In November 2011, the RCUK launched a Research Outcomes System (ROS). This is a web based system through which researchers and research organisations can supply information about the outcomes of their research to Research Councils. The information will be provided by Research Council funded project participants and will be used to help demonstrate the benefits of Research Council funded research and their contribution to the economic growth and societal wellbeing of the UK. Whilst not explicitly sated, the system should also have implications for the increased visibility and accessibility of UK Research Council funded activities.

In 2008, RCUK funded an independent study into open access, the purpose of which was to identify the effects and impacts of open access on publishing models and institutional repositories in light of national and international trends, including the impact of open access on the quality and efficiency of scholarly outputs, specifically journal articles. The report from the study was published in April 2009. In response, the Chief Executives of the Research Councils agreed that over time the UK Research Councils would support increased open access, by:

- building on their mandates on grant-holders to deposit research papers in suitable repositories within an agreed time period, and;
- extending their support for publishing in open access journals, including through the pay-to-publish model.

RCUK and HEFCE then launched a joint statement in support of open access to published research, which outlined the benefits of such a system and the needs for its successful implementation (clear licensing agreements, sustainable business models, working with the grain of established research cultures and practices). They also committed to “work together and with other interested bodies to support a managed transition to open access over the medium term, and welcome the work of the UK Open Access Implementation Group in support of this aim”. This statement was announced by the Minister for Universities and Science in a speech in May 2011. The Research Councils have agreed to invest £2m (€2.3m) in the development, by 2013, of a UK ‘Gateway to Research’ to allow ready access to Research Council funded research information and related data with later extension to include research funded by others.

Lastly, the Research and Innovation Strategy (BIS, 2011) notes that “the Government will open up access to core public datasets on transport, weather and health… by the end of this Parliament” and will “provide up to [€11.6m] over 5 years to establish an Open Data Institute to help industry exploit the

opportunities created through the release of this data. This will be developed by the TSB and will involve business and academic institutions".

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world

In order to develop an overarching national strategy for international engagement in R&D, as part of the Science and Innovation Strategic Framework 2004-2014, published in 2004, the government established a Global Science and Innovation Forum (GSIF). This charged GSIF with the design and implementation of the UK's Global Science and Innovation Strategy for international engagement in science and technology. GSIF brings together the main players in the promotion of international R&D in the UK in order "to coordinate a more evidence-based approach to international engagement, to ensure UK intervention in this area adapts to the evolving international economic and research environment and to evaluate the success of UK interventions" (GSIF, 2006). It is chaired by the Government's Chief Scientific Adviser. Its aims are to:

- Monitor implementation of the overarching UK strategy for international engagement in science and innovation, to update it and develop new recommendations where necessary.
- Provide advice on cross-governmental issues relating to the strategy, where there is a clear need for coordination in order to inform UK government policy and/or UK positions in international negotiations.
- Review UK activities with focus countries in line with the strategy, and where necessary provide advice on further coordination or new activities needed.
- Consider the implications of new evidence and trends relating to the UK's international science and innovation engagement, including evaluations of the various schemes to support this engagement.

In 2006, it published its strategy for international engagement in R&D. The strategy includes a framework of objectives to prioritise and coordinate the UK's international engagement in R&D, for each of which a number of focus countries are identified (EU member states are included as a single region). More recently, GSIF has come to act as a focal point for discussing international aspects of science and innovation across Government and its stakeholders.

Due to the large number of bi-and multi-lateral agreements for S&T cooperation that are in place at a range of levels, it is not possible to present even an aggregate assessment of the countries and research fields that are covered.

There are no specific rules regulating the UK's collaborations with third countries. Also, the priorities for international scientific and research collaboration are determined by an overlapping generic set of policy and economic principles and drivers (covering trade, innovation, research, development, political influence, etc.) and therefore will shift over time. Moreover, it is not the intention of GSIF (nor the Strategy) to prescribe partner countries or priority fields - rather it brings together a set of relevant stakeholders in order to coordinate and manage existing and emerging potential areas for collaboration in a way that is optimal for the varying policy needs of the UK. Thus, to provide a snapshot, the GSIF Strategy (GSIF, 2006), lists a number of countries with which the UK had bilateral scientific networking schemes, including China, India, Brazil, South Africa and South Korea. These were (and some still are) administered by the Royal Society and the total annual cost of the schemes to the UK at that time was €554,000. The government also ran the UK-India Education and Research Initiative (UKIERI) to encourage scientific collaboration with India. This had a budget of €14m from 2006-2011. Likewise, the British Council offers a number of exchange schemes for researchers from third countries (e.g. from Pakistan, Bangladesh, Kazakhstan and Afghanistan) while the Wellcome. Trust offers a range of travel grants in the medical sciences and ethics areas for non-UK residents to visit the UK or Ireland. Several other bodies concerned with research in scientific, social science and humanities fields also support cooperation with third countries. The recent Research and Innovation Strategy (BIS 2011), notes that particular focus for developing links with high growth economies will be given to China and India, and to extend these over time and as resources allow, to Brazil, Indonesia and others.

References

BIS (2009): Annual Innovation Report, November 2009.

BIS (2010b): R&D Scoreboard 2010, Available at: http://webarchive.nationalarchives.gov.uk/20101208170217/ http://www.innovation.gov.uk/rd_scoreboard/?p=3 (Accessed, December 9th 2011)

BIS (2011): Innovation and Research Strategy for Growth, BIS Economics Paper No 15, December 2011, Available at: http://www.bis.gov.uk/assets/biscore/innovation/docs/e/11-1386-economics-innovation-and-research-strategy-for-growth.pdf

BIS (2011): Innovation and Research Strategy for Growth, December 2011, Available at: http://www.bis.gov.uk/assets/biscore/innovation/docs/i/11-1387-innovation-and-research-strategy-for-growth.pdf

BIS, NESTA: 2010 Annual Innovation Report, January 2011

British Council, EURAXESS UK, The guide for international researchers moving to the UK, http://www.britishcouncil.org/new/PageFiles/12667/Euraxess%20final-researcher%20PDF.pdf

Cunningham, P.N., Sveinsdottir, T. and Gok, A. (2011): Mini-Country Report/United Kingdom. Thematic Report, ERAWATCH Network, July 2011.

Cunningham, P. and Karakasidou, A. (2009): Monitoring progress towards the ERA: UK Report. Report to the ERAWATCH ASBL.

DIUS (2008d): Science and Innovation Investment Framework 2004-14. Economic Impacts of Investment in Research & Innovation, December 2008, http://www.dius.gov.uk/publications/documents/Science/Science/2008_Economic_impact_report.pdf

European Commission (2006): 'She Figures 2006: Woman and Science, Statistics and Indicators', European Commission Directorate-General for Research, EUR22049, 2006.

European Commission (2007): Remuneration of Researchers in the Public and Private sectors, http://www.cipur.it/Varie/Forum%20DDL112/Study%20remuneration%20researchers.pdf

Eurostat (2009): Euro-Indicators: Gross domestic product - volumes - Percentage change, http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=0&language=en&pcode=na010q1

Eurostat (2011): Statistics on research and development, http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/main_tables

Global Science and Innovation Forum, A Strategy for International Engagement in Research And Development, October 2006.

Hauser, H. (2010): The Current and Future Role of Technology and Innovation Centres in the UK. Department for Business, Innovation and Skills, URN 10/843, March 2010.

HM Government (2009): Lisbon Strategy for Jobs and Growth: UK National Reform Programme. September 2008, http://www.parliament.uk/deposits/depositedpapers/2009/DEP2009-2449.pdf

HM Government (2011): Europe 2020: UK National Reform Programme 2011

HM Treasury and Department for Business, Innovation and Skills, The Plan for Growth: Implementation update, 29 November 2011

HM Treasury (2004): Science and Innovation Investment Framework 2004-2014, London: The Stationery Office, http://www.berr.gov.uk/dius/science/science-funding/framework/page9306.html

HM Treasury (2010): Comprehensive Spending Review, London: The Stationery Office, http://www.direct.gov.uk/prod_consum_dg/groups/dg_digitalassets/@dg/@en/documents/digitalasset/dg_191696.pdf

Malik, K., Cunningham, P.N., and Gagliardi, D. European TrendChart on Innovation: Innovation Policy Progress Report: United Kingdom 2008-2009, Published under the Innovation/SMEs Programme, European Commission, Directorate General for Enterprise, November 2009.

RCUK (2010): Large Facilities Roadmap 2010, http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/research/RCUKLargeFacilitiesRoadmap2010.pdf

Roberts, G. 'SET for Success: The supply of people with science, technology, engineering and mathematics skills', Report of a review for HM Treasury, April 2002

Technopolis, The impact of the EU RTD Framework Programme on the UK, 2010.

Tyler, P, Cambridge Economic Associates, Expert Evaluation Network: Delivering Policy Analysis on the Performance of Cohesion Policy 2007-2013: Task 1: Policy Paper on Innovation United Kingdom, August 2010, Report to the European Commission Directorate-General Regional Policy.

Universities UK and Research Councils UK (2005): The European Charter for Researchers and Code of Conduct for the Recruitment of Researchers: A UK HE gap analysis.

Universities UK, International research collaboration: Opportunities for the UK higher education sector, 2008.

List of Abbreviations

AHRC	Arts and Humanities Research Council
AIR	Annual Innovation Report (DIUS or BIS)
BBSRC	Biotechnology and Biological Sciences Research Council
BERD	Business Enterprise Expenditure on R&D
BERR	Department for Business, Enterprise and Regulatory Reform
BGF	Business Growth Fund
BIS	Department for Business, Innovation and Skills
BSSP	Business Support Simplification Programme
CBI	Confederation of British Industry
CERN	European Organisation for Nuclear Research
CIHE	Council for Industry and Higher Education
CSA	Chief Scientific Adviser
CSR	Comprehensive Spending Review
CST	Council for Science and Technology
DAs	Devolved Administrations
DCLG	Department for Communities and Local Government
DCMS	Department for Culture, Media and Sport
DEFRA	Department for Environment, Food and Rural Affairs
DELNI	Department of Employment and Learning
DFID	Department for International Development
DH	Department of Health
DIUS	Department for Innovation, Universities and Skills
DTI	Department of Trade and Industry
EIS	European Innovation Scoreboard
EPSRC	Engineering and Physical Sciences Research Council
ERA	European Research Area
ERDF	European Regional Development Fund
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructure
ESO	European Southern Observatory
ESRC	Economic and Social Research Council
ESRF	European Synchrotron Radiation Facility
EU	European Union
EU 25	European Union including the 25 Member States
EU 27	European Union including the 27 Member States
ExEFG	Export Enterprise Finance Guarantee
FE	Further Education
fEC	Full Economic Costing
FP	European Framework Programme for Research and Technology Development
FTE	Full-time Equivalent
G7	Group of seven industrialised nations
GBAORD	Government Budget Appropriations or Outlays for R&D
GDP	Gross Domestic Product
GERD	Gross Expenditure on R&D
GO-Science	Government Office for Science

GOVERD	Government Intramural Expenditure on R&D
GSIF	Global Science and Innovation Forum
HE	Higher Education
HE-BCI	Higher Education-Business and Community Interaction
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institutions
HEIF	Higher Education Innovation Fund
HERD	Higher Education Expenditure on R&D
HESA	Higher Education Statistics Agency
HM	Her Majesty's Treasury
HRST	Human Resources in Science and Technology
ISCED	International Standard Classification of Education
ISIC	International Space Innovation Centre
IU	Innovation Union
IUCR	Innovation Union Competitiveness Report 2011
IUCR	Innovation Union Competitiveness Report
JNCHES	the Joint Negotiating Committee for HE Staff
KTN	Knowledge Transfer Network
KTP	Knowledge Transfer Partnership
LCFC	Large Facilities Capital Fund
LEP	Local Economic Partnerships
LMB	the Laboratory of Molecular Biology
MoD	Ministry of Defence
MRC	Medical Research Council
NAO	National Audit Office
NERC	Natural Environment Research Council
NESTA	National Endowment of Science Technology and the Arts
NHS	National Health Service
NIHR	National Institute for Health Research
NRP	National Reform Programme
OECD	Organisation for Economic Co-operation & Development
ONS	Office for National Statistics
OSI	Office of Science and Innovation
PCT	Patent *Cooperation Treaty*
PPARC	Particle Physics and Astronomy Research Council
PRO	Public Research Organisation
PSA	Public Service Agreement
PSRE	Public Sector Research Establishment
QAA	Quality Assurance Agency
R&D	Research and Development
R&D&I	Research and Development and Innovation
R&I	Research and Innovation
RAE	Research Assessment Exercise
RCIF	Research Capital Investment Fund
RCUK	Research Councils UK
RDA	Regional Development Agency
REF	Research Excellence Framework
RO	Research Organisation
RTO	Research Technology Organisations
S&T	Science and Technology

SBRI	Small Business Research Initiative
SET	Science, Engineering and Technology
SIIF	Science and Innovation Investment Framework
SME	Small and Medium-sized Enterprise
SRIF	Science Research Investment Fund
STEM	Science, Technology, Engineering & Mathematics
STI	Science Technology and Innovation
STFC	Science and Technology Facilities Council
TIC	Technology Innovation Centre
TSB	Technology Strategy Board
UKRC	UK Resource Centre for Women in SET
UKTI	UK Trade and Investment
US PTO	United States Patent and Trademark Office
UTC	University Technical College

European Commission

EUR 25732 – Joint Research Centre – Institute for Prospective Technological Studies

Title: ERAWATCH country reports 2011:United Kingdom

Author(s): Paul Cunningham, Thordis Sveinsdottir & Abdullah Gok

Luxembourg: Publications Office of the European Union

2013– 37 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series –ISSN 1831-9424 (online)

ISBN 978-92-79-28135-8 (pdf)

doi:10.2791/61743

Abstract

The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

LF-NA-25732-EN-N

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

Publications Office

ISBN 978-92-79-28135-8

9 789279 281358